



DOP-MAJIIC2-071

**MAJIIC 2 STANAG 4607 GMTI IMPLEMENTATION GUIDE**  
**DOCUMENT VERSION 3.0**



**ATWG**



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***Abstract***

*This report builds upon the MAJIIC GMTI implementation guidelines described in MAJIIC DOP-MAJIIC-25 STANAG 4607 GMTI Implementation Guide v5.1. It is intended to provide implementation guidance to participants in MAJIIC 2 who will be implementing the standardization agreement (STANAG) 4607 ground moving target information format (GMTIF) within their simulation and exploitation system test-beds. The history that got us to this version of the guide is contained in the MAJIIC V5.1 Guide and will not be repeated here. This guide describes what an implementer needs to know about and support to participate in MAJIIC 2 experiments. These include a discussion on each 4607 segment format and in particular the protocol requirements for MAJIIC 2 SOA distribution. We are presently using the subsets of the latest edition, Edition 3.0 of the 4607 Standard with a test version of the new releasability segment. Additionally we are experimenting with real-time streaming distribution and streamed archival provided in a NNEC service based environment while maintaining important aspects backward compatible with MAJIIC. Specific changes to the implementation guidance will be documented in the relevant sections of this document. This is a living document and will be modified and updated from time-to-time as required.*

This document is a working paper that may not be cited as representing formally approved the NCI Agency opinions, conclusions or recommendations.

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This document consists  
of vi + 46 pages  
(excluding covers)

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## **EXECUTIVE SUMMARY**

This document provides guidance to the MAJIIC 2 community on how to implement support for STANAG 4607 Ed 3.0 [NATO STANAG 4607 Ed3, 2010] ground moving target indicator (GMTI) format in a MAJIIC 2 type environment.

This document is not intended to replace information in STANAG 4607 (see [NATO STANAG 4607 Ed3, 2010]) or in the Allied Engineering Document Publication 7 (AEDP-7) implementation guide (see [NATO AEDP-7 Ed2, 2013]). This document is intended to provide additional guidance to what is found in [NATO STANAG 4607 Ed3, 2010] and [NATO AEDP-7 Ed2, 2013].

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## TABLE OF CONTENTS

	Page
<b>1. INTRODUCTION</b>	<b>1</b>
<b>2. REQUIREMENTS</b>	<b>3</b>
1.1 MAJIC 2- OPERATIONAL-REQUIREMENTS	3
2.1 MAJIC 2- ARCHITECTURAL-REQUIREMENTS	3
2.2 MAJIC 2- TECHNICAL-REQUIREMENTS	4
<b>3. EXCHANGE GMTI USING THE 4607 STANAG EDITION 3.0</b>	<b>5</b>
<b>4. EXCHANGE GMTI VIA THE INTERNET</b>	<b>7</b>
<b>5. IMPLEMENT THE PRECISION TARGETING CLASS OF SEGMENTS</b>	<b>9</b>
5.1 PT EXPLOITATION CLASS	9
<b>6. OTHER MESSAGE SEGMENTS AND HEADERS</b>	<b>15</b>
6.1 PACKET HEADER	15
6.2 SEGMENT HEADER	16
6.3 MISSION SEGMENT	17
6.4 JOB DEFINITION SEGMENT	18
<b>7. RELEASABILITY SEGMENT</b>	<b>20</b>
7.1 TESTED SEGMENT CHANGES	20
<b>8. EXAMPLE: CREATING A STANAG 4607 PACKET STREAM</b>	<b>22</b>
<b>9. UDP PACKET SIZE MANAGEMENT</b>	<b>24</b>
9.1 EFFECT OF IP ENCRYPTION ON THE MOST EFFICIENT USE OF 4607 OVER UDP	24
9.2 SIZE DETAILS AND DWELL SPLITTING	25
9.3 SPLITTING TARGET REPORTS OVER MULTIPLE DWELL SEGMENTS	25
9.4 EXAMPLE USING MULTIPLE SEGMENTS	27
<b>10. STANAG 4607 TEST AND EVALUATION (T&amp;E)</b>	<b>30</b>
10.1 T&E REQUIREMENTS	30
10.1.1 RAW DATA (DIS) PATTERN GENERATOR OR DIS DATA FROM EXERCISE SAF	30
10.1.2 DOCUMENTED TEST PATTERNS OR TEST VIGNETTES	30
10.1.3 DATA REPLAYER	31
10.1.4 DATA LOGGER	31
10.1.5 AUTOMATIC FORMAT CHECKERS	31
10.1.6 STANAG 4607 VIEWER	31
10.1.7 SHARED REPORTING PORTAL	31
10.1.8 DEDICATED T&E TEAM	31
<b>APPENDIX A ANALYSIS OF CHANGES IN STANAG 4607 FOR EDITION 1 TO EDITION 2</b>	<b>32</b>
<b>APPENDIX B ANALYSIS OF CHANGES IN STANAG 4607 EDITION 3</b>	<b>42</b>
<b>REFERENCES</b>	<b>43</b>
<b>ABBREVIATIONS</b>	<b>45</b>

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## 1. INTRODUCTION

The NATO ground moving target indicator (GMTI) format, STANAG 4607 Edition 3.0, [NATO STANAG 4607 Ed3, 2010] is intended to supply message segments to enable the dissemination of MTI, SSR, Free Text and other message types in an operational context. STANAG 4607 has been designed so it can be used stand-alone or be incorporated in other proven formats, such as STANAG 4545 and STANAG 7023. Once STANAG 4607 was put forth for ratification it was felt that it would be appropriate for MAJIIC systems to implement some of the message segments within MAJIIC. The format was adopted by MAJIIC systems prior to the Technical Interoperability Experiment 2004 (TIE04), at NC3A, in October 2004. The format and MAJIIC use has evolved since then e.g. inclusion of the releasability segment, and inclusion of web services based streaming distribution.

Implementation of a data format is not a trivial task and to this day compromises were made and advantage was taken of any relevant previous work that could be leveraged to help the nations meet the demands of the task. The compromise that was agreed upon in Paris in 2004 was that the participating nations need only implement a subset of the STANAG 4607 message segments. In particular, only those message segments that directly relate to the dissemination of GMTI data would be implemented. This decision meant that SAR, SSR and Free Text message would still be passed using other formats or solutions outside of STANAG 4607. The previous work that could be leveraged to speed up the implementation process included work undertaken by Air Group IV identifying those message segments that need to be passed to enable Situational Awareness and Target Tracking activities to be carried out. This information is contained in AEDP-7, the GMTIF Implementation Guide, [NATO AEDP-7 Ed2, 2013]. Another source of STANAG 4607 experience is at AFRL in Rome (NY, USA). The engineers at AFRL have been involved with STANAG 4607 since its conception, and they have successfully demonstrated dissemination of streaming GMTIF for NGA with the RDOTS service.

The intent of this document is to collate all of the existing information necessary for a consistent implementation of STANAG 4607 for the MAJIIC 2 community. The particular format specifications and supporting documents will be referenced.

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## 2. REQUIREMENTS

MAJIIC 2 efforts have been guided by Operational User Requirements (OURs) and these have led to architectural and technical requirements.. These requirements are presently contained in a spreadsheet, see see [MAJIIC 2 Requirements Traceability Matrix, 2015].

Individual worksheets in each of the three categories, list the requirement IDs and requirement type, sub-type, name, description and category. These have been related to each other by cross referencing in matrices providing a operational to architectural mapping and a architectural to technical mapping. These will be maintained and continually updated and the reader is directed to that spreadsheet to get the latest mappings.

The following sections provides an extracted simplified list of GMTI-related requirements from the sources given above. The chapters following this one provide details on how to meet these requirements.

### 1.1 MAJIIC 2- OPERATIONAL-REQUIREMENTS

The operational users have generated requirements related to GMTI.

#### Operational:

1. The user shall be provided with the capability to access and use near real time streaming data.
2. The user shall be provided with the capability to access and use archived streaming data.

### 2.1 MAJIIC 2- ARCHITECTURAL-REQUIREMENTS

These lead to Architecture designers developing requirements to provide real time distribution architecture based on services and that is in progress. Real-time distribution is required to meet time sensitive target needs. The technical Subject Matter Experts (SME) is working to meet the Architectural requirements, which leads us to improve the present NIRIS tunnelling based distribution by interfacing to streaming services as they are defined. Based on this, the following requirements are derived.

#### GMTI Systems:

1. The user systems shall exchange GMTI using the 4607 STANAG Standard Edition 3.0 and AEDP 7
2. The user system shall support the ability to read or write GMTI in the 4607 standard via the internet.

For GMTI sources:

3. Shall send 4607 GMTI packets using UDP Broadcast on an assigned port number.
4. Shall comply with the CSD Streaming Service requirements and notify the CSD Streaming Service with the port number and status of the stream { NEW, CHANGED, OBSOLETE }.

For GMTI receivers:

5. Shall discover the GMTI Sensor and associated port number querying the CSD.

6. Shall receive and read the 4607 GMTI packets using a given port number.

## **2.2 MAJIIC 2- TECHNICAL-REQUIREMENTS**

A set of technical requirement set has been derived and the way to meet the requirements is described following this section.

### Required Segments:

1. The user system shall at a minimum implement the precision targeting class.
  - (i) Dwell segment with target reports
2. The user system shall at a minimum implement the Other Required Supporting Segments
  - (i) Packet header
  - (ii) segment headers
  - (iii) Mission segment
  - (iv) Job definition segment
3. The user system shall specify releasability using the compendium of extensions [NATO Compendium of Registered Extensions, 2010]
  - (i) releasability segment

Note: MAJIIC2 is testing an updated version of the releasability segment, [releasability segment CST Submittal , 2013] as published on the portal at

[https://majiic2.ncia.nato.int/Collaboration/releasability segment -CST Submittal.doc](https://majiic2.ncia.nato.int/Collaboration/releasability%20segment%20-CST%20Submittal.doc).

This is the version MAJIIC is testing as of the end of MAJIIC2. The updating continues centered around national coding methods and is in the hands of the 4607 Custodial Support Team.

### Broadcasting:

1. The GMTI creation systems shall broadcast the data using the user data protocol (UDP) and manage dwell target report splitting, to stay under the maximum transmission unit (MTU) size.
2. The GMTI creation systems shall account for encryption and distribution effects on packet size.

### **3. EXCHANGE GMTI USING THE 4607 STANAG EDITION 3.0**

Implementation of GMTIF standard alone does not guarantee interoperability. Compatibility must also be assured at other protocol layers. Certifiable implementation of the GMTIF for support of interoperability is subject to constraints not specified in this STANAG. MAJIC 2 constraints to implementing STANAG 4607 is documented in this Implementation Guide.

Additionally, an allied engineering document publication (AEDP), see [NATO AEDP-7 Ed2, 2013], contains helpful information. STANAG 4607 Standard refers to AEDP-7 as it provides implementation guidance, test and validation procedures, a configuration management plan, and amplifying information for STANAG 4607. It includes a notional employment concept for using the GMTIF, a suggested technique for embedding GMTIF data into NATO imagery formats, suggested groupings of GMTIF data fields to support three data exploitation classes, and tutorial information pertaining to the GMTIF. AEDP-7 also includes a registry of controlled extensions, which have been approved for use with STANAG 4607 (see [NATO Compendium of Registered Extensions, 2010]).

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## **4. EXCHANGE GMTI VIA THE INTERNET**

MAJIIC 2 exchange requirements in the MAJIIC Architecture Requirements Document (MARD) presently calls for sensor systems to broadcast GMTI packets to the web on an assigned port number. Exploitation systems learn of these port numbers and listens on their local LANs for the data. Sensors pack up dwell targets detections into packets following the 4607 standard and this guide to generate size controlled precision targeting GMTI packets.

The requirement to support CSD publication or automatic NCI Agency CSD ingestion and thus that mode of GMTI archival is likely to end and be replaced with archival of streams.

A manually configured all-to-all tunnelling system called NIRIS, insures the GMTI is available on all the LANs. This is due to be replaced in MAJIIC but will be maintained for a while as we test the new services based exchange.

This section is likely to change in the future and sensors will likely be notifying a notification service that they are streaming locally. That service may be queried so a streaming server could gather and buffer the stream for others. It may also notify the MAJIIC community it has streams for non-local distribution and may support mirroring that stream by other non-local servers. Ultimately the architecture should allow an exploiter to ask for and get the data he desires on his local network. This does not exist yet but stay tuned.

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## 5. IMPLEMENT THE PRECISION TARGETING CLASS OF SEGMENTS

In their AEDP document Air Group IV originally recommended a number of Exploitation Classes that define the specific 4607 message segments and data fields that are deemed necessary in order for particular exploitation activities to be undertaken.

The Exploitation Class categories identified in the AEDP originally were:

1. Situation awareness (SA)
2. Area targeting (AT)
3. Basic tracking (BT)
4. Precision targeting and advanced tracking (PT)
5. Precision targeting and advanced tracking with high range resolution (HT)

This list of exploitation classes has been modified in later versions of the AEDP but the PT class listed initially remains the preferred exploitation class for MAJIIC 2. Consequently, this document will only describe the use of the PT exploitation class. Using the PT exploitation class as a guide, the specific segments and data fields to be used for the exchange of data in MAJIIC 2 can be selected. The PT segments include: packet header, segment header, mission segment, job segment, dwell w/target report and MAJIIC 2 is adding the new releasability segment.

The following tables detail the recommended data fields in the dwell segment of STANAG 4607 (including the target reports), and the estimated packet sizes for the PT exploitation class is determined. The size is important to understand because it help is insure we can calculate how we stay under the UDP Broadcast Maximum Transmission Unit MTU size.

For completeness, tables indicating the available fields of the dwell segment and target report, taken from the STANAG 4607 specification, are provided. The tables provided below include only the segments and headers required for the transmission of GMTI target information. They do not include other data segments defined in STANAG 4607 that would be required in order to transmit other segments (e.g., mission segment, job definition segment, releasability etc.) necessary for conveying a complete and coherent information set, these will be discussed in following sections.

### 5.1 PT EXPLOITATION CLASS

The PT exploitation class is defined as containing all data available for the precision targeting of MTI with precision location systems, such as GPS, and for the automatic tracking of MTI targets using advanced tracking algorithms. Note that the dwell segment and target report data fields recommended for the PT exploitation class for MAJIIC 2 differ from that contained in the original STANAG 4607 AEDP. This is because of decisions made when CAESAR first implemented STANAG 4607 GMTIF: that we would use high resolution latitude and longitude values in preference to scaled values, the addition of the uncertainty estimates for sensor position and sensor track/speed and that the minimum detectable velocity (MDV) field should be sent in the body of the dwell segments. Each of the target reports for MAJIIC were expected to send high resolution target positions rather than deltas, the target measurement uncertainties and the truth tag field. Inclusion of these fields is recommended to support target registration analysis and advanced tracking during the TIE and future MAJIIC exercises or experiments.

Note that since MAJIIC, relative latitude and longitude values are supported by MAJIIC 2. It is up to systems to weigh up the benefits of reduced data transmission versus greater accuracy, taking into consideration the effect of their decisions on the ability of coalition partners to use their data. Note that in order to use the reduced bandwidth relative target locations the dwell segment must contain the scale factor information in fields D10 and D11 of the dwell segment. Sensor systems using the relative form of the target location must complete fields D10 and D11 of the dwell segment and D32.4 and D32.5 of each target report segment. Guidance for setting the scale factor and for turning absolute locations into relative locations is provided in AEDP-7. The type of location information that is being used will be reflected in the existence mask for each system and must be set to be the outputting sensor system and decoded by each user of the data.

Systems and simulators that are incapable of sending particular data will be allowed to send appropriate default, no-statement, or don't-care data (as defined in the data fields) or, in the case of the dwell segment and target reports, use the existence mask to indicate fields which are not transmitted in the STANAG 4607 data stream. The generators of such data should be aware that sending an incomplete PT class may impact the capability of the data to be used for 'precision targeting and advanced tracking' which is the primary purpose of the PT class. Within MAJIIC 2 the fields defined for the PT class should be treated as mandatory unless it is impossible to obtain the information. This structure would give the MAJIIC 2 trackers the best data to work with, and increase the probability of valid tracks being produced.

Table 1  
Data fields for precision targeting and advanced tracking Exploitation Class for MAJIIC 2

EXPL. CLASS	SEGMENT	FIELD NAME	FIELD REF.	SIZE (Bytes)
Precision Targeting and Advanced Tracking	Dwell segment (Body)	Existence Mask	D1	8
		Revisit Index	D2	2
		Dwell Index	D3	2
		Last Dwell of Revisit	D4	1
		Target Report Count	D5	2
		Dwell Time	D6	4
	Total Bytes using Absolute Target Locations = 75 Or Relative Target Locations = 83	Sensor Position Lat/Long/Altitude	D7-D9	12
		Scale Factor Lat/Long Scale	D10-D11	8
		Sensor Position Uncertainties	D12-D14	10
		Sensor Track and Speed	D15-D16	6
		Sensor Track/Speed Uncertainties	D18-D19	3
		Platform Orientation	D21-D23	6
		Dwell Area	D24-D27	12
		Sensor Orientation	D28-D30	6
		MDV	D31	1
			See Note below	Abs 75 total) (Rel 83,total)
	Target Report*	MTI Report Index	D32.1	2
		Target Location Hi-Res Lat/Long	D32.2- D32.3	8
		Target Relative Location Delta Lat/Long	D32.4 – D32.5	4
		Target Location Geodetic Height	D32.6	2
		Target Velocity LOS Component	D32.7	2
		Target Wrap Velocity	D32.8	2
		Target SNR	D32.9	1
		Target Classification	D32.10	1
		Target Class. Probability	D32.11	1
		Target Measurement Uncertainties	D32.12- D32.15	7
		Truth Tag	D32.16- D32.17	5
		Target RCS	D32.18	1
			See Note below	(Abs 32,total) (Rel 28,total)

\*NOTE: The target report data fields are repeated for each additional reported target

Table 2  
Dwell segment for STANAG 4607 Ed 3

Field	Type	Field Name		Bytes	Form	Value Range	Units
D1	M	Existence Mask		8	FL64	Per Para. 2.4.1	
D2	M	Revisit Index		2	I16	0 to 65535	
D3	M	Dwell Index		2	I16	0 to 65535	
D4	M	Last Dwell of Revisit		1	FL8	0,1	Flag Bit
D5	M	Target Report Count		2	I16	0 to 65535	
D6	M	Dwell Time		4	I32	0 to 4 x (10 <sup>9</sup> )	milliseconds
D7	M	Sensor Position	Latitude	4	SA32	- 90 to +89.999999958	degrees
D8	M		Longitude	4	BA32	0 to +359.999999916	degrees
D9	M		Altitude	4	S32	-50000 to +2 billion	centimeters
D10	C	Scale Factor	Lat Scale	4	SA32	Per AEDP-7 para 2.4.10	degrees
D11	C		Long Scale	4	BA32	Per AEDP-7 para 2.4.11	degrees
D12	O	Sensor Position	Along Track	4	I32	0 to 1,000,000	centimeters
D13	O	Uncertainty (one standard deviation)	Cross Track	4	I32	0 to 1,000,000	centimeters
D14	O		Altitude	2	I16	0 to 65525	centimeters
D15	C	Sensor Track		2	BA16	0 to 359.9945	degrees (CW from True North)
D16	C	Sensor Speed		4	I32	0 to 8000000	millimeters/sec
D17	C	Sensor Vertical Velocity		1	S8	-128 to +127	decimeters/sec
D18	O	Sensor Track Uncertainty		1	I8	0 to 45	degrees
D19	O	Sensor Speed Uncertainty		2	I16	0 to 65535	millimeters/sec
D21	C	Platform Orientation	Heading	2	BA16	0 to 359.9945	degrees (CW from True North)
D22	C		Pitch	2	SA16	-90 to +89.9973	degrees
D23	C		Roll (Bank Angle)	2	SA16	-90 to +89.9973	degrees
D24	M	Dwell Area	Center Latitude	4	SA32	- 90 to + 89.999989	degrees
D25	M		Center Longitude	4	BA32	0 to +359.999979	degrees
D26	M		Range Half Extent	2	B16	0 to 255.9928	kilometers
D27	M		Dwell Angle Half Extent	2	BA16	0 to 359.9945	degrees
D28	O	Sensor Orientation	Heading	2	BA16	0 to 359.9945	degrees
D29	O		Pitch	2	SA16	-90 to +89.9973	degrees
D30	O		Roll	2	SA16	-90 to +89.9973	degrees
D31	O	Minimum Detectable Velocity, MDV		1	I8	0 to 255	decimeters/sec

\* Note that the Dwell segment for STANAG 4607 Ed 3 is identical to STANAG 4607 Ed 2

Table 3  
Target report for STANAG 4607 Ed 3

Field	Type	Field Name		Bytes	Form	Value Range	Units
D32.1	C	MTI Report Index		2	I16	0 to 65535	none
D32.2	C	Target Location	Hi-Res Latitude	4	SA32	- 90 to +89.999999958	degrees
D32.3	C		Hi-Res Longitude	4	BA32	0 to +359.999999916	degrees
D32.4	C		Delta Latitude	2	S16	-32768 to 32767	
D32.5	C		Delta Longitude	2	S16	-32768 to 32767	
D32.6	O		Geodetic Height	2	S16	-1000 to +32767	meters
D32.7	O	Target Velocity Line-of-Sight Component		2	S16	-32768 to +32767, where + means increasing range away from the sensor	centimeters/sec
D32.8	O	Target Wrap Velocity		2	I16	0 to 65535	centimeters/sec
D32.9	O	Target SNR		1	S8	-128 to +127	dB
D32.10	O	Target Classification		1	E8	Per Para. 2.4.32.10.	
D32.11	O	Target Class. Probability		1	I8	0 to 100	percent
D32.12	C	Target Measurement Uncertainty (one standard deviation)	Slant Range	2	I16	0 to 65535	centimeters
D32.13	C		Cross Range	2	I16	0 to 65535	decimeters
D32.14	C		Height	1	I8	0 to 255	meters
D32.15	C		Target Radial Velocity	2	I16	0 to 5000	centimeters/sec
D32.16	C	Truth Tag	Application	1	I8	0, 1 to 255	
D32.17	C		Entity	4	I32	0, 1 to 4294967295	
D32.18	O	Target Radar Cross Section		1	S8	-128 to +127	dB/2

\* Note that the only difference between the Target Report for STANAG 4607 Ed 3 and STANAG 4607 Ed 2 is the addition of the 'optional Target Radar Cross Section' byte.

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## 6. OTHER MESSAGE SEGMENTS AND HEADERS

As stated in the previous section it is necessary to send more than just dwell segments in order to enable simulators to read, decode, and use GMTI data feeds effectively. There was a precedent set in the spring of 2003 when the precision tracking (PT) exploitation transmission was implemented in STANAG 4607 MTI radar.

The segments and headers used in the demonstration are considered as a starting point for the MAJIC 2 implementation of STANAG 4607. The headers used were the packet header and segment header. The segments used were the job definition segment and mission segment along with the dwell segment. The dwell segment is sent for each dwell of the radar beam. It provides information related to dwells and revisits, the sensor location, the coverage area, the time of the dwell, sensor orientation, and sensor parameters. It includes target reports for any GMTI detections observed within that dwell and shall be sent even if no targets are detected. There are issues arising when the size of the dwell segment exceeds the maximum UDP packet size of 1472 bytes. These issues will be addressed in subsequent sections of this document. There are also issues for those simulators which do not simulate radar dwells, again these will be addressed later.

The job definition segment and mission segment are of short, fixed length whereas, as indicated in Section 5, the size of the dwell segment is dependent upon the number of targets in the dwell. The mission segment provides information concerning the mission plan, the flight plan, the platform type and configuration, and the reference time for the mission. The job definition segment provides a definition of the radar job performed by the sensor, including information pertaining to the geolocation model used in the sensor measurement. Note that precision location of a target will not be possible until the information contained in the job definition segment has been received from the transmitting platform. For completeness, the data tables and introductory text for the platform header and segment header along with the mission and job definition segments are reproduced below from the STANAG 4607 ratification request document. Note that the paragraph references in the following tables refer to the source STANAG 4607 format document for details of specific data fields in the packet header and segment header and the mission and job definition segments.

### 6.1 PACKET HEADER

The packet header shall be sent at the beginning of each packet. It identifies the format version of the data contained in the packet, the size of the packet, and information pertaining to the platform, security, and the mission. When broadcast over UDP the maximum packet size will be necessarily limited to 1472 bytes.

Note that MAJIC 2 systems should use field P1 of the packet header to identify or determine the version of STANAG 4607 data format that is being transmitted or received. The correct value for STANAG 4607 Ed 3.0 formatted data would be '30'.

Table 4  
packet Header

Field	Type	Field Name		Bytes	Form	Value Range	Units
P1	M	Version ID		2	A	Per Para. 2.1.1	
P2	M	Packet Size		4	I32	32 to 4294967295	bytes
P3	M	Nationality		2	A	Alphanumeric	FIPS Pub 10-4
P4	M	Packet Security	Classification	1	E8	Per Para. 2.1.4	
P5	M		Class. System	2	A	Per Para. 2.1.5	
P6	M		Code	2	FL	Per Para. 2.1.6	
P7	M	Exercise Indicator		1	E8	Per Para. 2.1.10	
P8	M	Platform ID		10	A	Alphanumeric	(e.g., Tail No.)
P9	M	Mission ID		4	I32	Per Para. 2.1.9	
P10	M	Job ID		4	I32	0, 1 to 4294967295	

## 6.2 SEGMENT HEADER

A segment header, which defines the type of message and the length (in bytes) of the following segment, precedes each message segment. Message segments that have been identified for use in MAJIIC were; mission segment, dwell segment, and job definition segment.

The segment header (Table 5) shall be sent at the beginning of each segment transmitted within a packet. It identifies the type and size of the segment as shown in the following table. Note that the value for all possible 4607 segments is indicated in the table not just the values for the segments to be used in MAJIIC 2.

Table 5  
segment Header

Field	Type	Field Name	Bytes	Form	Value Range	Units
S1	M	segment Type	1	E8	1 = Mission segment 2 = Dwell segment 3 = HRR segment 4 = Range-Doppler segment 5 = Job Definition segment 6 = Free Text segment 7 = Low Reflectivity Index segment 8 = Group segment 9 = Attached Target segment 10 = Test and Status segment 11 = System-Specific segment 12 = Processing History segment 13 = Platform Location segment 14-100 = Reserved for new Segments 101 = Job Request segment 102 = Job Acknowledge segment 103-127 = Reserved for future use 128-255 = Reserved for Extensions	
S2	M	segment Size	4	I32	Refer to para. 2.2.2 of [Ref 3]	

### 6.3 MISSION SEGMENT

The mission segment provides information concerning the mission and shall be sent periodically at least once every two minutes. It includes information on the mission and flight plans, the type and configuration of the platform, and the reference time. Note that the dwell time (field D6) specified in any associated dwell segments is referenced to the reference time (fields M5-M7) in the mission segment, and will not be resolved as to the day of the mission until the mission segment is received from the transmitting platform.

Table 6  
Mission segment

Field	Type	Field Name	Bytes	Form	Value Range	Units
M1	M	Mission Plan	12	A	Alphanumeric	BCS Set
M2	M	Flight Plan	12	A	Alphanumeric	BCS Set
M3	M	Platform Type	1	E8	Per para 2.3.3	
M4	M	Platform Configuration	10	A	Alphanumeric	BCS Set
M5	M	Reference Time	Year	I16	e.g., 2002	
M6	M		Month	I8	1 to 12	
M7	M		Day	I8	1 to 31	

#### **6.4 JOB DEFINITION SEGMENT**

The job definition segment provides the means for the platform to pass information pertaining to the sensor job that will be performed and details of the location parameters (terrain elevation model and geoid model) used in the measurement. It includes a definition of the geographic area for sensor service, which is defined as a four-corner polygon, with the four points of the polygon chosen to define a convex quadrilateral. The job definition segment shall be sent before the first revisit of a job and shall be sent periodically, at least once every thirty seconds thereafter.

Table 7  
Job Definition segment

Field	Type	Field Name		Bytes	Form	Value Range	Units
J1	M	Job ID		4	I32	0 to 4294967295	
J2	M	Sensor ID	Type	1	E8	Per para. 2.7.2	
J3	M		Model	6	A	Per para. 2.7.3	
J4	M	Target Filtering Flag		1	FL8	Per para. 2.7.4	
J5	M	Priority (Radar Priority)		1	I8	1 to 99, 255 (1 is highest, 99 is lowest and 255 indicates End of Job)	
J6	M	Bounding Area	Pt A Latitude	4	SA32	- 90 to + 89.999989	degrees
J7	M		Pt A Longitude	4	BA32	0 to +359.999979	degrees
J8	M		Pt B Latitude	4	SA32	- 90 to + 89.999989	degrees
J9	M		Pt B Longitude	4	BA32	0 to +359.999979	degrees
J10	M		Pt C Latitude	4	SA32	- 90 to + 89.999989	degrees
J11	M		Pt C Longitude	4	BA32	0 to +359.999979	degrees
J12	M		Pt D Latitude	4	SA32	- 90 to + 89.999989	degrees
J13	M		Pt D Longitude	4	BA32	0 to +359.999979	degrees
J14	M	Radar Mode		1	E8	Per para. 2.7.14	
J15	M	Nominal Revisit Interval		2	I16	0,1 to 65535	deciseconds
J16	M	Nominal Sensor Position Uncertainty	Along Track	2	I16	0 to 10000, 65535=No Statement	decimeters
J17	M		Cross Track	2	I16	0 to 10000, 65535=No Statement	decimeters
J18	M		Altitude	2	I16	0 to 20000, 65535=No Statement	decimeters
J19	M		Track Heading	1	I8	0 to 45, 255=No Statement	degrees
J20	M		Sensor Speed	2	I16	0 to 65534, 65535=No Statement	millimeters/sec
J21	M	Nominal Sensor Value	Slant Range Standard Deviation	2	I16	0 to 65534, 65535=No Statement	centimeters
J22	M		Cross Range Standard Deviation	2	BA16	0 to 179.9945, ≥180.0=No Statement	degrees
J23	M		Target Velocity Line-of- Sight Component Standard Deviation	2	I16	0 to 5000, 65535=No Statement	centimeters/sec
J24	M		MDV	1	I8	0 to 254, 255=No Statement	decimeters/sec
J25	M		Detection Probability	1	I8	0 to 100, 255=No Statement	Percent
J26	M		False Alarm Density	1	I8	0 to 254, 255=No Statement	negative dB
J27	M	Terrain Elevation Model Used		1	E8	Per para. 2.7.27	
J28	M	Geoid Model Used		1	E8	Per para. 2.7.28	

## 7. RELEASABILITY SEGMENT

As of 2010 the Releasability extension (RE) segment became available and is viewed as a good enhancement to the 4607 STANAG. The segment provides a beneficial way to express releasability with values other than the old limited packet Header P6 “codes”. The releasability segment is being adopted to improve the ability of MAJIIC 2 systems to better state the releasability of the GMTI. In our experiment case this is implemented by listing the MAJIIC nations which is not naturally available in the packet header P6 fields.

Note that in Table 5, segment Type – Field S1 is shown to have a range of reserved values [128-255] for ‘Registered Extensions’. These extensions are contained in the ‘Compendium of Registered Extensions to the NATO ground moving target indicator (GMTI) Format’ [NATO Compendium of Registered Extensions, 2010].

### 7.1 TESTED SEGMENT CHANGES

MAJIIC 2 tested the new RE segment in TIE12 and then created a MAJIIC change request to align the design with STANAG 4545 RELCCA and simplify usage. These RE changes were designed to:

1. Ensure that releasability information is only reported in either the packet header or the RE. This means not using the RE in combination with any REL TO value in the packet header P6 field.
2. Limit usage of RE to one segment per packet, the data following the RE segment will have that releasability.
3. Drop the REL TO Entity Types (R4), and use a similar approach as used for target reports in the dwell segment, see below.
4. Since no existence mask is used, set all fields to mandatory. A listing can be zero length by setting its count to zero, again as used for target reports.
5. Modify the table 4-5 Releasability extension to match the RELCCA nesting format as close as possible.
  - (i) Date Time
  - (ii) Coalitions /w or w/o associated nations,
  - (iii) Nations,
  - (iv) Government and non-government organizations.

Table 8 below presents the restructured segment.

Table 8  
MAJIIC 2 Changed Releasability extension segment

Field	Type	Field Name		Bytes	Form	Value Range	Units
R1	M	Release Determination Date	Year	2	I16	e.g., 2002	
R2	M		Month	1	I8	1 to 12	
R3	M		Day	1	I8	1 to 31	
R4	M	REL TO Coalitions Count		1	I8	0 to 255	
		<REL TO Coalition Listing>				Per Para. 4.5.5	
R5	M	REL TO Nations Count		1	I8	0 to 255	
		<REL TO Nation Listing>				Per Para. 4.5.7	
R6	M	REL TO (N)GO Count		1	I8	0 to 255	
		<REL TO (N)GO Listing>				Per Para. 4.5.9	

It is not the intention of this document to reproduce the information in the RE change document, such a course would be nugatory and may lead to confusion. If there is need for specific MAJIIC 2 guidance on what should be entered into the specific fields of the releasability segment it is provided in the change document on the MAJIIC 2 portal.

During MAJEX12 we tested this modified releasability segment and determined we desired an increase to the coalition name character field length from 4 to 10. That change was tested in MAJEX13. The change request document is on the MAJIIC 2 portal and will guide the future implementation and testing in MAJIIC 2.

## 8. EXAMPLE: CREATING A STANAG 4607 PACKET STREAM

The technical issues involved in sending STANAG 4607 GMTIF messages have been discussed in the previous sections. The STANAG 4607 message segments that are necessary to deliver the PT class have then been described.

In a MAJIIC 2 environment some key configuration values such as nationality code and system symbolic name and IP port number are required to operate

The GMTI generator or exploiter is expected to locate and obtain the required information. To learn these values the user will access Test Plan, ORBAT, System Specification and ATO/ACO to get this data. Once the user has these then filling in the GMTI fields and connecting to the internet is possible. New MAJIIC 2 Services are being discussed to provide these details and users will likely need to access these services.

The STANAG 4607 message segments that have been proposed are the same message set that were used by AFRL in a TIE 2003 demonstration with the addition of the new releasability segment. As a consequence it is recommended that the simplicity of the AFRL approach to the distribution of the message segments be maintained.

Packet header and releasability segment lead off every packet, a segment header leads off each segment as segments sent in the packet then follow. The first segment which is sent in a packet is the mission segment. Prior to the start of the first dwell of a scan or frame a job definition segment is sent in a packet. Then as a dwell is performed and target reports come in, sufficient STANAG 4607 UDP packets, containing dwell segments, are then sent to account for all the target reports required in the dwell, target report splitting over multiple packets is performed as necessary to get all the targets sent while staying under the MTU size. Prior to the next frame or scan a new job definition segment is sent, and then the new dwell segments.

In accordance with the STANAG 4607 document, the mission segment is sent periodically, at least once every two minutes. In the implementation of this scheme the mission segment, job definition segment and dwell segments were sent in separate packets, this should be maintained. An example implementation at the packet level is given in the table below for consideration.

Table 9  
Mapping between sensor/platform events and STANAG 4607 packets

Sensor/Platform Event	STANAG 4607 packets
On Station	Mission segment
Start of First Visit	Job Definition segment
First Radar Dwell	Dwell segment(s)
Second Radar Dwell	Dwell segment(s)
...subsequent Dwells	Dwell segment(s)
Last Dwell of Revisit	Dwell segment(s)
First or Subsequent Revisits	Job Definition segment
First Radar Dwell	Dwell segment(s)
Second Radar Dwell	Dwell segment(s)
...subsequent Dwells	Dwell segment(s)
Last Dwell	Dwell segment(s)

Note: The mission segment is sent on a periodic basis every 2 minutes. For each sensor/platform event one or more packets will be required for transmission over UDP. Each UDP packet contains data from only one event.

## 9. UDP PACKET SIZE MANAGEMENT

The STANAG 4607 format document does not specify a particular transmission protocol to carry the formatted data. However, the EX format had been designed from its initial conception to be a broadcast format transported on a local area network/wide area network (LAN/WAN) via UDP. As a consequence, the EX format has been designed to acknowledge the constraints imposed by the maximum UDP packet size of 1472 bytes. Although the STANAG 4607 format was not designed with such constraints in mind, there are mechanisms in the format that will allow us to tailor the message segments to allow broadcast over UDP in MAJIIC.

Within the STANAG 4607 format the packet size, field P2 of the packet header, is 4 bytes and so, allows a packet size of up to 4,294,967,295 bytes. The convention for constructing STANAG 4607 packets allows multiple data segments to be included in a packet (with each data segment preceded by a segment header) but it also allows data to be sent in multiple packets. If the transmission media for a STANAG 4607 packet limits the size of the packets, it may be necessary to send the STANAG 4607 data in multiple packets.

MAJIIC 2 defined a maximum packet sizes became when using Ethernet to not exceed the Maximum Transmission Unit (MTU) size and thus prevent packet fragmentation. To do this MAJIIC manages the maximum number of targets sent in each packet to control the size to be under the MTU.

The total data size for dwells, containing various numbers of targets when the PT Exploitation class is used to define dwell segments and target reports, can be used to calculate the total packet size, as these sizes are combined with the packet and segment headers to create valid packets in accordance with STANAG 4607 convention detailed below.

Note that the size of the dwell segment body and of a target report may be smaller than the figures given here due to the non-transmission of optional fields. This practice is to be discouraged for MAJIIC. Note also that the figures here are for systems using absolute target locations. When relative target locations i.e. delta lat/long are used, the dwell segment will be eight bytes larger but each target report will be four bytes smaller so the total bytes needed will be reduced.

### 9.1 EFFECT OF IP ENCRYPTION ON THE MOST EFFICIENT USE OF 4607 OVER UDP

The basis of the previous arguments in this section is that for the most efficient use of UDP on the LAN the maximum UDP packet should be constrained to 1472 bytes. This number keeps the Ethernet packet below the maximum transfer unit (MTU) of 1500 bytes and so prevents arbitrary packet slicing and re-assembly at the receiving end. Thus, it reduces the probability of packet loss and prevents additional latency.

When internet protocol (IP) encryption devices are introduced into the architecture, as they will be when data is sent over the combined federated battle labs network (CFBLNet), there is an overhead introduced that ought to be factored in to the size of the maximum packet that the application creates. In terms of broadcasting STANAG 4607 GMTIF over CFBLNet, this effectively means that for efficiency purposes the applications should reduce the number of targets sent in a dwell segment to keep the transmitted packet below the MTU.

Experience on another current project at NC3A is that to take into account multiple ‘tunnelling’ the maximum available packet size should be ~ 1300 bytes not the 1472 bytes that is used over the LAN. Using the figures from Table 8 this means that the maximum number of targets in any dwell segment ought to be limited to 3.5. Note that these are not absolute figures as the maximum number of targets in a dwell may vary from system to system due to the use of the existence mask, size of the releasability segment.

For the purposes of the CFBLNet test in the TIE it would be useful if simulators could make the maximum number of targets output per dwell a configurable item. Then as the system fills packets the user could check the packet total size and reduce the target limit if needed.

Table 10  
packet sizes for precision targeting and advanced tracking

SEGMENT NAME	PACKET SIZE(NO. OF TARGETS)			
	(1)	(35)	(100)	(1000)
Packet Header	32	32	32	32
segment Header	5	5	5	5
Release segment (Variable size)	34	34	34	34
segment Header	5	5	5	5
Dwell segment - Body	75	75	75	75
Dwell segment - Target Report(s)	32	1120	3200	32000
<i>TOTAL BYTES:</i>	<i>144</i>	<i>1271</i>	<i>3351</i>	<i>32151</i>

As you can see then to stay under the MTU size ~35 targets per packet are allowed. When you have more targets in a dwell we have to implement dwell splitting.

## 9.2 SIZE DETAILS AND DWELL SPLITTING

Of the three STANAG 4607 PT segments proposed for implementation, and after taking account of packet headers and segment headers, only the size of the dwell segment might cause the 4607 packet to exceed the maximum UDP broadcast packet size. It can be ascertained from Table 8 above that this would occur when the number of target detections in a dwell exceeds 35 for PT EX class. In this case the number of target reports in the dwell segment would cause the size of the dwell segment to exceed 1120 causing the whole packet, including the packet and segment headers, to exceed 1300 bytes. In such a circumstance it is recommended that, in the short term; advantage is taken of STANAG 4607 mechanisms to split message segments into manageable 1271 byte packets.

## 9.3 SPLITTING TARGET REPORTS OVER MULTIPLE DWELL SEGMENTS

When using UDP as the transport mechanism and encryption, the maximum packet size is limited to ~1300 bytes. Consequently, when sending a 4607 packet that would exceed the 1300 byte limitation the 4607 packet must be sent using multiple UDP packets. This situation can easily occur when sending dwell segments containing target reports. For illustrative purposes, assume that the transmission packet length is constrained to the UDP packet size of 1300 bytes and that the number of bytes to send a large number of target reports exceeds the allowable UDP packet size. In this case, the first packet would be constructed to send the maximum number of reports without exceeding the packet size limitation and the excess reports would be sent in additional packets. Table 8 summarizes the packet

sizes for the PT EX class when a notional maximum number of targets is sent in a single packet of 1300 bytes

Table 11  
Notional maximum number of targets to fit 1300 byte packet

ITEM	PT
Packet Header (Bytes)	32
segment Header (Bytes)	5
releasability segment	~34
segment Header (Bytes)	5
Dwell segment – Body (Bytes)	75
Dwell segment - Target Report (Bytes)	1120 (35x32)
TOTAL:	1271

As we have seen above, the dwell segment might have to be broken up into multiple UDP packets when its total length exceeds 1300 bytes. To do this we want to take advantage of a mechanism in STANAG 4607. It is important any mechanism must ensure that the loss of packets due to the use of UDP is not disastrous to the recipient of the data. One departure from the STANAG 4607 specification that is considered necessary is the suggestion to increment the MTI Index over the complete dwell rather than resetting at the start of each dwell segment.

The fields of the dwell segment that allow multiple dwell segments to be transmitted are shown in Table 12.

Table 12  
Dwell segments used to define multiple dwell segments

Revisit Index	D2
Dwell Index	D3
Last Dwell of Revisit	D4

The revisit index is set to 0 for the first time an area is scanned and then incremented for every subsequent revisit (Note: the revisit index can wrap around). The dwell index (D3) is set to 0 for the first dwell of a revisit and incremented for each new dwell in a revisit. The last dwell of revisit field (D4) is set to 0 for every dwell in a revisit with the exception of the last dwell of a revisit for which it is set to 1. When the number of target reports for a dwell exceeds the UDP packet size multiple UDP packets are needed to transmit one dwell, only the dwell segments in the UDP packets for the final dwell should have the last dwell of revisit set. Those systems or simulators that do not model a radar dwell need to send a complete ‘scan/frame’ as a ‘dwell’. This can be achieved by the process of setting the dwell index (D3) to 0 and the last dwell of revisit (D4) to 1 in all of the multiple UDP packets forming the dwell. There are two indicators that a new frame has started; the revisit index is incremented and the MTI report index is reset.

## 9.4 EXAMPLE USING MULTIPLE SEGMENTS

Note that this example assumes that all of the fields in the PT EX class are transmitted i.e. none are masked out by use of the existence mask. Simulation systems that mask out some of the fields indicated in the PT EX class by use of the existence mask will reduce the size of the dwell segment and/or target report and the number of target reports which will fit in a packet will be increased. In that case the numbers in the calculations below need to reflect the individual systems.

As an example of sending target reports in multiple packets, assume that 60 target reports captured in a single radar dwell are to be sent in support of a PT: EX class and that the transmission packet size is limited to 1300 bytes. From Table 10 the maximum number of targets that can be reported in one PT UDP packet is 35. Therefore, the reports must be sent in multiple packets. The process for constructing the packets is as follows:

### UDP packet 1:

- Create the first packet header :
  - Set the packet size (P2 of the packet Header) to 1271 (i.e., the size to carry 35 target reports);
  - Set the platform, mission, and job IDs (P8-P10) as required;
  - Set remaining parameters as required.
- Create the first segment header:
  - Set the segment Type (S1) to 132 (indicating a releasability segment is to be sent);
  - Set the segment size (S2) to 39 (the size of the segment header and the release segment).
- Create the releasability segment
 

Set the fields as desired.
- Create the first dwell segment header:
  - Set the segment Type (S1) to 2 (indicating a dwell segment is to be sent);
  - Set the segment size (S2) to 1200 (the size of the segment header and the dwell segment with 35 target reports).
- Create the first dwell segment
  - Set the fields as described in data fields for precision targeting and advanced tracking (PT), Table 2, with target report count set to 60 (the total number of targets in the dwell). If this is the first dwell of a revisit increment the revisit index ;
  - Set the parameters for the first 35 target reports with the MTI report index (D32.1) set to 0 (decimal) for the first target report and to 34 (decimal) for the last target report in this packet.
  - Set the dwell index (D3) to 0
  - Set the last dwell of revisit (D4) to 0

### UDP packet 2:

- Create the second packet header:
  - Set the packet size (P2) to 971 (the size to carry the 25 excess target reports that could not be carried in the first packet);
  - Set the platform, mission, and job IDs (P8-P10) to the same parameters as in the

- first packet header;
  - Set remaining parameters as in the first packet header.
- Create the first segment header:
  - Set the segment Type (S1) to 132 (indicating a releasability segment is to be sent);
  - Set the segment size (S2) to 39 (the size of the segment header and the release segment).
- Create the releasability segment
  - Set the fields as desired.
- Create the second segment header:
  - Set the segment type (S1) to 2 (indicating a dwell segment is to be sent);
  - Set the segment size to 880 (the size of the segment header and the dwell segment with 25 target reports).
- Create the second dwell segment:
  - Set the fields as described in the first dwell segment for the data fields for PT, Table 2, with target report count set to the total number of targets in the dwell, in this case 60;
  - Set the parameters for the last 25 target reports, as described in Table 2, with the MTI report index (D32.1) set to 35 (decimal) for the first target report and to 59 (decimal) for the last target report.
  - Set the dwell index (D3) to 0
  - Set the last dwell of revisit (D4) to 0

Note: If this dwell were the last dwell of the revisit then for MAJIIC 2 using UDP the ‘last dwell of revisit’ field would be set to 1 in each of the packets.

Although simplistic, the proposed mechanism should work for UDP transmission as shown above and can easily be extended to target reports from a dwell far in excess of the 60 shown in the example. An important point to note is that each of the multiple dwell segment UDP packets forming a dwell are linked by having the same dwell segment header information. Another point which has been the cause of non-compliance in the past is the use of the ‘Target Report Count’ field to hold the number of targets in the complete dwell **not** the number of targets in the packet. This was suggested because otherwise nowhere else in this scheme is there a declaration of the number of targets in the complete dwell. This means that the exploitation systems have to use other means to determine how many targets are in each packet e.g. the size of a target report and the dwell segment size, this is not trivial when existence masks have to be considered.

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## 10. STANAG 4607 TEST AND EVALUATION (T&E)

### 10.1 T&E REQUIREMENTS

It has been shown since MAJEX07 that a comprehensive test and evaluation regime provides great benefit to a MAJIIC exercise and experiment. Tools available for allowing the generation and testing of STANAG 4607 data allow producers to produce and check the format of the STANAG 4607 they produce and to obtain a correlation of the raw data with the STANAG 4607 data displayed. Additionally, if Exploiters of STANAG 4607 data receive early data samples from producers they can highlight any issues with the data. All of this activity has previously been performed offline prior to an exercise and means that time is not wasted when the systems come together for an exercise or experiment. This regime is not limited to simulated data, it is even more critical to the success of an exercise that data samples from any live systems participating in an exercise are made available for pre-testing.

For MAJIIC 2 there are unclassified and classified MAJIIC testbeds that will enable sites to connect remotely over VPN or CFBLNet.

A basic set of requirements for enabling a test regime are shown below. These may be provided as applications or 'services'. A brief description of each of the detailed requirements for each application/service follows:

- A selection of core services
- Raw data (DIS) pattern generator or DIS data from exercise SAF
- Documented test patterns or test vignettes
- Data replayer
- Data Logger
- Automatic format checkers
- STANAG 4607 viewer
- Shared reporting portal
- Dedicated T&E team

#### 10.1.1 Raw data (DIS) pattern generator or DIS data from exercise SAF

The raw data that feeds MAJIIC platform and sensor simulators arrives in the form of Distributed Interactive Simulation (DIS) Entity State PDUs. Hence the capability to generate DIS PDUs via a pattern generator or to be provided with DIS PDUs from the SAF to be used is the starting point for the T&E activity. In fact the starting point is a little before this when the tests to be performed are defined by the T&E group. In the past both pattern generators, such as the AFRL supplied 'DIS clock' and simulated vignettes from JCATS have been used. There are advantages for both types of tests, so ideally both should be performed. The pattern generator allows for greater control of the test scenario but use of the actual SAF allows checks to be performed on the actual DIS implementation in the SAF including; Protocol, Timestamps and Volume. The benefit is that provided the data is appropriately classified it can be played and tests can be performed in isolation at the national site.

#### 10.1.2 Documented Test Patterns or Test Vignettes

It is crucial that the test patterns or test vignettes are documented and that when the STANAG 4607 output data is produced the tests are clearly referenced so that exploiters of the data have some idea of what the expected output will be. Key to this activity is the production of a T&E

document by the T&E group. It is also desirable that the designers of the test patterns and test vignettes exercise all facets of the simulation e.g. enough targets so that the STANAG 4607 packet splitting over UDP is forced, DIS enumerations etc.

### **10.1.3 Data Replayer**

The raw DIS data is normally supplied in the form of a DIS log and in order to play the data back a data replayer is required. The T&E group standardised on the use of a NC3A logger/replayer to eliminate possible problems of enumerable log formats. The NC3A logger was used in testing prior to MAJEX07 without any problems.

### **10.1.4 Data Logger**

The raw data is supplied in the form of a DIS Log, but in order for the STANAG 4607 producers to supply STANAG 4607 output data that data needs to be logged as well. Fortunately, the NC3A Logger can be used to log STANAG 4607 data as well as it is just a UDP logger. DIS data is basically UDP packets as is the MAJIIC STANAG 4607 broadcast data. With everybody using the same logger and replayer compliance problems are avoided.

### **10.1.5 Automatic format checkers**

The use of automatic format checkers such as AFRLs validator and NC3A's OANT tool allow precise checking of the STANAG 4607 data against the STANAG 4607 data format specification and the MAJIIC implementation guide.

### **10.1.6 STANAG 4607 viewer**

A useful tool is a 'STANAG 4607 viewer'. The ultimate STANAG 4607 viewer is a native exploitation system. All suppliers of STANAG 4607 are encouraged to view their data locally before they distribute data samples. If the data is not right on a local machine it is unlikely that it will be correct on any of the other national systems. If a STANAG 4607 producer does not have access to an exploitation system it would be circumspect to implement a basic viewer as part of the simulator.

### **10.1.7 Shared reporting portal**

In order to make the testing regime work it is important that all participants have access to a T&E area in which data and reports, queries and advice can be shared. Since MAJEX07 and Trial Quest NC3A hosted an area on the MAJIIC portal. Although access to the portal was only through an NC3A portal manager data and reports was shared effectively. It is to be determined if the NCI Agency will maintain this capability.

### **10.1.8 Dedicated T&E team**

The founding of the Test & Evaluation sub group prior to MAJEX07 was fundamental to the success of that exercise and that of Trial Quest. A stringent test regime meant that systems were well prepared prior to arrival at NC3A and the benefit was quickly illustrated by reduced integration time and in a reduction of fundamental data areas between systems. It is critical that the T&E team remain in place for MAJEX08 and that the lesson that pre-exercise testing is important is heeded.

## APPENDIX A ANALYSIS OF CHANGES IN STANAG 4607 FOR EDITION 1 TO EDITION 2

The following tables present the analysis of the differences in STANAG 4607 Edition 1.0, 1.1 and 2.0. The tables were provided by Gerry Bright from the AFRL.

Table A.1  
Legend applicable for the tables in Appendix A

	Same as in previous version or edition
	Need to check for possible impact
	Need to update code from previous version
	Not adopted for MAJIIC used as of MAJEX 08

Table A.2  
packet Header segment

4607	MAJIIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Version ID		P1				
M	M	Packet Size		P2				
M	M	Nationality		P3				NATO platforms changed from "NA" to "XN"
M	M	Packet security	Classification	P4				Now set per packet, not per file
M	M		Classification System	P5				Now set per packet – NATO changed from “NS” to “XN”
M	M		Code	P6				Nations to publish their own security handling code

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Exercise indicator		P7				
M	M	Platform ID		P8				
M	M	Mission ID		P9				
M	M	Job ID		P10				If the Job ID in the packet Header is 0 (hex 0x00), then the packet cannot contain Dwell, HRR, or Range-Doppler segments.

Table A.3  
segment Header segment

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	segment Type		S1				Some Numbers reserved for future use or extensions and a reference to AEDP-7, for additional segments which have been approved for use with STANAG 4607
M	M	segment Size		S2				

Table A.4  
Mission segment

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Mission Plan		M1				
M	M	Flight Plan		M2				

4607	MAJIIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Platform Type		M3				Ed2's New Platform Table was adopted in 1.1
M	M	Platform Configuration		M4				
M	M	Reference Time	Year	M5				
M	M		Month	M6				
M	M		Day	M7				

\* NOTE: Please note that the Dwell segment of Edition 2.0 may be sent only if the Job ID in the associated packet Header is not equal to zero (hex 0x00).

Table A.5  
Dwell segment

4607	MAJIIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Existence Mask		D1				
M	M	Revisit Index		D2				
M	M	Dwell Index		D3				
M	M	Last Dwell of Revisit		D4				
M	M	Target Report Count		D5				total number of targets reported during this dwell
M	M	Dwell Time		D6				
M	M	Sensor Position	Latitude	D7				
M	M		Longitude	D8				
M	M		Altitude	D9				Value range increased to -50000 to + 2 billion (bytes and form did NOT change) - centimetres in text.

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
C	-NA-	Scale Factor	LatScale	D10				Not adopted for MAJEX 08
C	-NA-		LongScale	D11				Not adopted for MAJEX 08
O	O	Sensor Position Uncertainty (one standard deviation)	Along Track	D12				
O	O		Cross Track	D13				
O	O		Altitude	D14				Unit changed from decimetres to centimetres - Value range increased (bytes and form did NOT change)
C	C	Sensor Track		D15				
C	C	Sensor Speed		D16				
C	C	Sensor vertical velocity		D17				
O	O	Sensor Track Uncertainty		D18				
O	O	Sensor Speed Uncertainty		D19				
O	-NA-	Sensor Vertical Velocity Uncertainty		D20				Not adopted for MAJEX 08
C	C	Platform Orientation	Heading	D21				
C	C		Pitch	D22				
C	C		Roll (Bank Angle)	D23				
M	M	Dwell Area	Center Latitude	D24				
M	M		Center Longitude	D25				
M	M		Range Half Extent	D26				
M	M		Dwell Angle HalfExtent	D27				
O	O	Sensor Orientation	Heading	D28				Text adopted to allow for electronic beam steer
O	O		Pitch	D29				Text adopted to allow for electronic

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
								beam steer
O	O		Roll	D30				Text adopted to allow for electronic beam steer
O	O	Minimum Detectable Velocity MDV		D31				
		Target reports		D32				Reference change

Table A.6  
Target Reports

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
C	C	MTI Report Index		D32.1				Increments within the dwell not the segment.
C	C	Target Location	Hi Res Latitude	D32.2				Each of the target reports for MAJIC is currently expected to send high resolution target positions rather than Deltas
C	C		High Res Longitude	D32.3				Each of the target reports for MAJIC is currently expected to send high resolution target positions rather than Deltas
C	-NA-		Delta Lat	D32.4				Not adopted for MAJEX 08
C	-NA-		Delta Long	D32.5				Not adopted for MAJEX 08
O	O		Geodetic Height	D32.6				Value range increased to -1000 to + 32767 (bytes and form did NOT change)

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
O	O	Target Velocity Line of Sight Component (Radial Velocity)		D32.7				Description calls out also known as "Radial Velocity"
O	O	Target Wrap Velocity		D32.8				
O	O	Target SNR		D32.9				
O	O	Target Classification		D32.10				
O	O	Target Classification Probability		D32.11				
C	C	Target Measurement Uncertainty (one standard deviation)	Slant Range	D32.12				
C	C		Cross Range	D32.13				
C	C		Height	D32.14				
C	C		Target radial Velocity	D32.15				
C	C	Truth Tag	Application	D32.15				
C	C		Entity	D32.16				

\*NOTE: Please note that the Bounding Area within the Job Definition segment of Edition 2.0 the Bounding Area shall remain fixed for a given Job ID.

Table A.7  
Job Definition segment

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Job ID		J1				Zero not allowed
M	M	Sensor ID	Type	J2				Table Extended Sensors added
M	M		Model	J3				
M	M	Target Filtering Flag		J4				

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M	Priority (Radar Priority)		J5				1 to 99, 255 (1 is highest 99 is lowest and 255 indicates end of Job)
M	M	Bounding Area	Pt A Latitude	J6				
M	M		Pt A Longitude	J7				
M	M		Pt B Latitude	J8				
M	M		Pt B Longitude	J9				
M	M		Pt C Latitude	J10				
M	M		Pt C Longitude	J11				
M	M		Pt D Latitude	J12				
M	M		Pt D Longitude	J13				
M	M	Radar Mode		J14				Radar Modes Table Updated. ( ASARS-AIP, Reserved, ASARS-2 )
M	M	Nominal revisit Interval		J15				
M	M	Nominal Sensor Position Uncertainty	Along Track	J16				
M	M		Cross Track	J17				
M	M		Altitude	J18				
M	M		Track Heading	J19				
M	M		Sensor Speed	J20				
M	M	Nominal Sensor Value	Slant Range Standard Deviation	J21				
M	M		Cross Range Standard Deviation	J22				Changed from I16 to BA16 in all MAJIC Implementation guides. Formally adopted in Edition 2
M	M		Target Velocity Line of Sight Component Standard Deviation	J23				Changed from B16 to I16 in all MAJIC Implementation guides. Formally adopted in Edition 2

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	M		MDV	J24				
M	M		Detection Probability	J25				Definition of Probability changed adding – “assuming the Swerling Model appropriate for the particular radar target.” See STANAG 4607 ANNEXB Section 3.10 for models.
M	M		False Alarm Density	J26				
M	M		Terrain Elevation Model Used	J27				
M	M		Geoid Model Used	J28				Note that no DTED earth model will be specified in Field J27 when the Geoid Model Used in field J28 is selected to be Flat Earth

Table A.8  
Segments not used by MAJIC

Segments	Remarks
High Range Resolution segment	
Free Text segment	
Test and Status segment	
Processing History segment	
Platform Location segment	altitude changed as in D9
Job Request segment	
Job Acknowledge segment	Job Id changed as in J1; Start time added.

Table A.9  
HRR segment (not used in MAJIIC)

4607	MAJIIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
M	-NA-	Revisit Index.		H1				Zero not allowed
M	-NA-	Dwell Index.		H2				Table Extended Sensors added
M	-NA-	Last Dwell of Revisit		H3				
M	-NA-	MTI Report Index		H4				
M	-NA-	Number of Target Scatterers		H5				
M	-NA-	Mean Clutter Power relative to peak scatterer		H6				
M	-NA-	Detection Threshold Relative To peak scatterer		H7				
M	-NA-	Range resolution		H8				
M	-NA-	Range Bin Spacing		H9				
M	-NA-	Doppler Resolution		H10				Value range changed to .0078125 to 255 (bytes and form did NOT change)
M	-NA-	Doppler Bin Spacing		H11				Value range changed to .0078125 to 255 (bytes and form did NOT change)
M	-NA-	Compression Flag		H12				
M	-NA-	Range Weighting Function Type		H13				
M	-NA-	Doppler Weighting Function Type		H14				
M	-NA-	Maximum Pixel Power		H15				
M	-NA-	<HRR Scatterer		H16				Reference changed

4607	MAJIC	Data element			Edition 1.0	Edition 1.1	Edition 2.0	
		Records>						

## APPENDIX B ANALYSIS OF CHANGES IN STANAG 4607 EDITION 3

The following tables present the analysis of the differences in STANAG 4607 Edition 2.0 and 3.0. The tables were provided by Gerry Bright from the AFRL.

Table B.1  
Legend applicable for the tables in Appendix B

	No Change from Previous Edition
	Effects Library and/or Validator
	Effects User Use - Input or Output
	Adopted for MAJIIC use after MAJEX08
	Not Adopted for MAJIIC use as of MAJEX 12

Please note that if a system sends in the packet Header (P1) Version ID = "10,20,30" then this indicates the use of appropriate version of HRR.

- 10 gets HRR edition 1
- 20 gets HRR edition 2 (also same as edition 1);
- 30 gets HRR edition 3 restructured and longer using existence mask

Table B.2  
packet Header segment

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	M	Version ID		P1			
M	M	Packet Size		P2			
M	M	Nationality		P3			
M	M	Packet security	Classification	P4			no classification option removed
M	M		Classification System	P5			more countries

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	M		Code	P6			REL 9-EYES change of countries
M	M	Exercise indicator		P7			
M	M	Platform ID		P8			
M	M	Mission ID		P9			
M	M	Job ID		P10			

Table B.3  
segment Header

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	M	segment Type		S1			
M	M	segment Size		S2			

Table B.4  
Mission segment

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
M	M	Mission Plan		M1			
M	M	Flight Plan		M2			
M	M	Platform Type		M3			new platform type Twin Otter
M	M	Platform Configuration		M4			
M	M	Reference Time	Year	M5			
M	M		Month	M6			
M	M		Day	M7			

Table B.5  
Dwell segment

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
M	M	Existence Mask		D1			32.18 field added
M	M	Revisit Index		D2			
M	M	Dwell Index		D3			
M	M	Last Dwell of Revisit		D4			
M	M	Target Report Count		D5			
M	M	Dwell Time		D6			
M	M	Sensor Position	Latitude	D7			
M	M		Longitude	D8			
M	M		Altitude	D9			

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
C	C	Scale Factor	LatScale	D10			
C	C		LongScale	D11			
O	O	Sensor Position Uncertainty (one standard deviation)	Along Track	D12			
O	O		Cross Track	D13			
O	O		Altitude	D14			
C	C	Sensor Track		D15			
C	C	Sensor Speed		D16			
C	C	Sensor vertical velocity		D17			
O	O	Sensor Track Uncertainty		D18			
O	O	Sensor Speed Uncertainty		D19			
O	-NA-	Sensor Vertical Velocity Uncertainty		D20			
C	C	Platform Orientation	Heading	D21			
C	C		Pitch	D22			
C	C		Roll (Bank Angle)	D23			
M	M	Dwell Area	Center Latitude	D24			
M	M		Center Longitude	D25			
M	M		Range Half Extent	D26			
M	M		Dwell Angle Half Extent	D27			
O	O	Sensor Orientation	Heading	D28			
O	O		Pitch	D29			
O	O		Roll	D30			
O	O	Minimum Detectable		D31			

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
		Velocity MDV					
		Target reports		D32			

Table B.6  
Target Reports

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
C	C	MTI Report Index		D32.1			
C	C	Target Location	Hi Res Latitude	D32.2			
C	C		High Res Longitude	D32.3			
C	C		Delta Lat	D32.4			
C	C		Delta Long	D32.5			
O	O		Geodetic Height	D32.6			
O	O	Target Velocity Line of Sight Component (Radial Velocity)		D32.7			
O	O	Target Wrap Velocity		D32.8			
O	O	Target SNR		D32.9			
O	O	Target Classification		D32.10			New target classifications
O	O	Target Classification Probability		D32.11			
C	C	Target Measurement Uncertainty (one standard deviation)	Slant Range	D32.12			
C	C		Cross Range	D32.13			
C	C		Height	D32.14			

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
C	C		Target radial Velocity	D32.15			
C	C	Truth Tag	Application	D32.16			
C	C		Entity	D32.17			
O	O	Target Radar Cross Section		D32.18			New data field

\*NOTE: Please note that the Job Definition segment of Edition 2.0 provides rules for the bounding areas and resending of Job Definition Segments.

Table B.7  
Job Definition segment

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	M	Job ID		J1			
M	M	Sensor ID	Type	J2			new sensor types
M	M		Model	J3			
M	M	Target Filtering Flag		J4			
M	M	Priority (Radar Priority)		J5			
M	M	Bounding Area	Pt A Latitude	J6			
M	M		Pt A Longitude	J7			
M	M		Pt B Latitude	J8			
M	M		Pt B Longitude	J9			
M	M		Pt C Latitude	J10			
M	M		Pt C Longitude	J11			
M	M		Pt D Latitude	J12			

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
M	M		Pt D Longitude	J13			
M	M	Radar Mode		J14			new radar modes
M	M	Nominal revisit Interval		J15			bounding area usage change
M	M	Nominal Sensor Position Uncertainty	Along Track	J16			
M	M		Cross Track	J17			
M	M		Altitude	J18			
M	M		Track Heading	J19			
M	M		Sensor Speed	J20			
M	M	Nominal Sensor Value	Slant Range Standard Deviation	J21			
M	M		Cross Range Standard Deviation	J22			
M	M		Target Velocity Line of Sight Component Standard Deviation	J23			
M	M		MDV	J24			
M	M		Detection Probability	J25			
M	M		False Alarm Density	J26			
M	M		Terrain Elevation Model Used	J27			
M	M		Geoid Model Used	J28			

Table B.8  
Segments not used in MAJIIC 2

Segments	Remarks
Free Text segment	
Test and Status segment	
Processing History segment	
Processing Record	
Platform Location segment	
Job Request segment	
Job Acknowledge segment	
High Range Resolution 2 segment	
High Range Resolution 3 segment	Changes
Scatter Record	

Table B.9  
Free Text segment (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Originator ID		F1			
M	-NA-	Recipient ID		F2			
M	-NA-	Free Text		F3			

Table B.10  
Processing History segment (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Job Id		T1			
M	-NA-	Revisit Index		T2			
M	-NA-	Dwell Index		T3			
M	-NA-	Dwell Time		T4			
M	-NA-	Hardware Status		T5			
M	-NA-	Mode Status		T6			

Table B.11  
Platform Location segment (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Location time		L1			
M	-NA-	Platform Position	Latitude	L2			
M	-NA-		Longitude	L3			
M	-NA-		Altitude	L4			
M	-NA-	Platform Track		L5			
M	-NA-	Platform Speed		L6			
M	-NA-	Platform Vertical Speed		L7			

Table B.12  
Job Request segment (Not used in MAJIIC 2)

	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Requestor ID		R1			
M	-NA-	Requestor Task ID		R2			
M	-NA-	Priority (Requestor Priority)		R3			
M	-NA-	Bounding Area	Pt A Latitude	R4			
M	-NA-		Pt A Longitude	R5			
M	-NA-		Pt B Latitude	R6			
M	-NA-		Pt B Longitude	R7			
M	-NA-		Pt C Latitude	R8			
M	-NA-		Pt C Longitude	R9			
M	-NA-		Pt D Latitude	R10			
M	-NA-		Pt D Longitude	R11			
M	-NA-	Radar Mode		R12			
M	-NA-	Radar Resolution	Range	R13			
M	-NA-		Cross-Range	R14			
M	-NA-	Earliest Start Time	Year	R15			
M	-NA-		Month	R16			
M	-NA-		Day	R17			
M	-NA-		Hour	R18			
M	-NA-		Minutes	R19			
M	-NA-		Seconds	R20			
M	-NA-		Allowed Delay	R21			

	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Duration Value		R22			
M	-NA-	Revisit Interval		R23			
M	-NA-	Sensor ID	Type	R24			
M	-NA-		Model	R25			
M	-NA-	Request Type		R26			

Table B.13  
Job Acknowledge segment (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	JOB ID		A1			
M	-NA-	Requestor ID		A2			
M	-NA-	Requestor Task ID		A3			
M	-NA-	Sensor ID	Type	A4			
M	-NA-		Model	A5			
M	-NA-	Priority (Radar Priority)		A6			
M	-NA-	Bounding Area	Pt A Latitude	A7			
M	-NA-	Bounding Area	Pt A Longitude	A8			
M	-NA-		Pt B Latitude	A9			
M	-NA-		Pt B Longitude	A10			
M	-NA-		Pt C Latitude	A11			
M	-NA-		Pt C Longitude	A12			
M	-NA-		Pt D Latitude	A13			

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
M	-NA-		Pt D Longitude	A14			
M	-NA-	Radar Mode		A15			
M	-NA-	Duration		A16			
M	-NA-	Revisit Interval		A17			
M	-NA-	Request Status		A18			
M	-NA-	Radar Job Start Time	Year	A19			
M	-NA-		Month	A20			
M	-NA-		Day	A21			
M	-NA-		Hour	A22			
M	-NA-		Minutes	A23			
M	-NA-		Seconds	A24			
M	-NA-	Requestor Nationality ID		A25			

Table B.14  
HRR segment Edition 2 (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Revisit Index.		H1			
M	-NA-	Dwell Index.		H2			
M	-NA-	Last Dwell of Revisit		H3			
M	-NA-	MTI Report Index		H4			
M	-NA-	Number of Target Scatterers		H5			
M	-NA-	Mean Clutter Power relative to peak scatterer		H6			
M	-NA-	Detection Threshold Relative To peak scatterer		H7			
M	-NA-	Range resolution		H8			
M	-NA-	Range Bin Spacing		H9			
M	-NA-	Doppler Resolution		H10			
M	-NA-	Doppler Bin Spacing		H11			
M	-NA-	Compression Flag		H12			
M	-NA-	Range Weighting Function Type		H13			
M	-NA-	Doppler Weighting Function Type		H14			
M	-NA-	Maximum Pixel Power		H15			
M	-NA-	<HRR Scatterer Records>		H16			

As mentioned above, please note that if a system sends in the packet Header (P1) Version ID = "10,20,30" then this indicates the use of appropriate version of HRR.

- 10 gets HRR Edition 1
- 20 gets HRR Edition 2 (also same as edition 1);
- 30 gets HRR Edition 3 restructured and longer using existence mask

Table B.15  
HRR segment Edition 3 (Not used in MAJIC 2)

4607	MAJIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Existence Mask		H1			New field
M	-NA-	Revisit Index.		H2			
M	-NA-	Dwell Index.		H3			
M	-NA-	Last Dwell of Revisit		H4			
M	-NA-	MTI Report Index		H5			
M	-NA-	Number of Target Scatterers		H6			
M	-NA-	Number of Range Samples/Total Scatterers		H7			New data field
M	-NA-	Number of Doppler Samples		H8			New data field
M	-NA-	Mean Clutter Power relative to peak scatterer		H9			
M	-NA-	Detection Threshold Relative To peak scatterer		H10			
M	-NA-	Range resolution		H11			
M	-NA-	Range Bin Spacing		H12			
M	-NA-	Doppler Resolution		H13			

M	-NA-	Doppler Bin Spacing		H14			
C	-NA-	Center Frequency		H15			
M	-NA-	Compression Flag		H16			
M	-NA-	Range Weighting Function Type		H17			
M	-NA-	Doppler Weighting Function Type		H18			
M	-NA-	Maximum Pixel Power		H19			
O	-NA-	Maximum RCS		H20			New data field
C	-NA-	Range of Origin		H21			New data field
C	-NA-	Doppler of Origin		H22			New data field
M	-NA-	Type of HRR/RDM		H23			New data field
M	-NA-	Processing Mask		H24			New data field
M	-NA-	Number Bytes Magnitude		H25			New data field
M	-NA-	Number Bytes Phase		H26			New data field
O	-NA-	Range Extent In Pixels		H27			New data field
O	-NA-	Range To Nearest Edge In Chip		H28			New data field
O	-NA-	Index Of Zero Velocity Bin		H29			New data field
O	-NA-	Target Radial Electrical		H30			New data field
O	-NA-	Electrical Length Uncertainty		H31			New data field
		<HRR Scatterer Records>		H32			

Table B.16  
Scatterer record (Not used in MAJIIC 2)

4607	MAJIIC	Data element			Library/ Validator	Input/ Output	
M	-NA-	Scatterer Magnitude		H32.1			change in bytes and range
O	-NA-	Scatterer Phase		H32.2			change in bytes and range and type
C	-NA-	Range Index		H32.3			change in range and type
C	-NA-	Doppler Index		H32.4			change in range and type



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## ABBREVIATIONS

AFRL	Air Force Research Laboratories
AT	Area targeting
BCS	Basic Character Set
CAESAR	Coalition Aerial Surveillance and Reconnaissance
CFBLNet	Combined Federated Battle Labs Network
CW	Clockwise
dB	Decibel
ESM	electronic warfare support measures
EX	exercise
FIPS	Federal Information Processing Standard
GMTI	ground moving target indicator
GMTIF	ground moving target indicator format
HRR	high range resolution
HT	precision targeting and advanced tracking with high range resolution
IP	Internet Protocol
LAN	local area network
LOS	line of sight
MAJIIC	Multi-Sensor Aerospace-ground Joint ISR Interoperability Coalition
MAJIIC 2	Multi-Intelligence All Source Joint Intelligence, Surveillance and Reconnaissance (ISR) Interoperability Coalition
MDV	minimum detectable velocity
MTI	moving target indicator
MTU	maximum transfer unit
NACT	NATO Alliance Ground Surveillance Capability Testbed
PT	precision targeting (and advanced tracking)
RRS	Rome Research Site
SA	situational awareness
SAR	synthetic aperture radar
SNR	signal to noise ratio

SSR	Sensor Service Requests
STANAG	NATO standardization agreement
TIE	Technical Interoperability Experiment
TIWG	Technical Interoperability Working Group
UDP	User Datagram Protocol
WAN	wide-area network

